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Art. VII.—*Notes on Australian and New Zealand Foraminifera. No. 1.—The Species of Patellina and Patellinella, with a Description of a new Genus, Annulopatellina.*

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(With Plate IV.)

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Introduction.

The object of this series of papers is to review the species of foraminifera found living and fossil in the Australian and New Zealand region. It is proposed to deal with one or more related genera in each paper.

The foraminifera of the Indo-Pacific area are of especial interest. Many of the species of the Eocene of the Paris Basin are found in the Oligocene and Miocene of Victoria, and some, or closely related forms, are still living on the Australian coast and elsewhere in the shallower waters of the Indian and Pacific Oceans. The Miocene faunas of Austria and Hungary are also represented here, while, as Dr. J. A. Cushman has recently pointed out, the living fauna of the Caribbean and West Indian region is much more like that of the Australian region than any other.

With the exception of *Patellina*, the genera now studied are confined to the Indo-Pacific. The genus *Patellina* has recently been the subject of a paper by Cushman (1930, pp. 11-17, pl. iii), to which the present notes may be regarded as supplementary. *Patellinella* is known by a single species, *P. inconspicua* (Brady), and has been considered by some authors to be unrelated to *Patellina* or to other genera of the Rotaline group. The discovery of a more primitive species of *Patellinella*, showing without doubt that *Patellinella* has evolved from *Patellina*, is therefore of great interest. The third genus is a new one which we have erected to receive *Orbitolina annularis* Parker and Jones, a species common in South Australian waters, which differs in several important points from the true *Orbitolinae* and *Patellinae* with which it has been grouped.

For much help in the form of material from the important localities of Europe and elsewhere, and valuable advice, we are indebted to our friend, Mr. Frederick Chapman, A.L.S., etc., the Commonwealth Palaeontologist. We are also under obligations to Dr. J. A. Cushman, of Sharon, U.S.A., for his assistance.

Description of Species.

Genus **Patellina** Williamson, 1858.

Patellina corrugata Williamson.

(Plate IV, Figs. 1-5.)

Patellina corrugata Williamson, 1858, p. 46, pl. iii, figs. 86-89.
Chapman, 1909B, p. 354; 1915, p. 28; 1916, pp. 338, 359, 377.
Heron-Allen and Earland, 1922, p. 198, pl. vii, fig. 5.

Description.—Test spiral, trochoid, concave inferiorly, early whorls usually undivided, later whorls consisting of long crescentic chambers, about two to the whorl, divided into chamberlets by septa; septa of varying length, sometimes in alternating series of two or more orders, arising from the peripheral margin of the chamber, and stopping short of the inner margin, where all the chamberlets communicate; umbilical area filled by an exogenous growth of shelly material in which there are thickened ridges arranged in an irregularly coiled pattern; aperture not visible; wall calcareous, hyaline, perforate.

Diameter.—0·3-0·4 mm.

Observations.—Cushman has suggested that the species of *Patellina* present in the Indo-Pacific region is *P. advena* Cushman, a species described from the Lower Oligocene (Mint Spring Calcareous Marl), Mint Spring Bayou, Vicksburg, Miss., U.S.A. We have examined a large series of specimens, both fossil and recent, from Australia and New Zealand, and after comparing them with examples of *P. corrugata* from the British Isles, are of the opinion that they are identical with Williamson's species. There is some variation in the degree of fineness of the secondary septation. Three examples illustrating this, from the one dredging, are figured on Plate IV. Fig. 2 represents a megalospheric specimen. This is coarsely subdivided as in the examples of *P. corrugata* at hand from the British Isles. Fig. 4 is a microspheric example, very finely subdivided. It agrees with one we have, through the kindness of Dr. Cushman, from the Lower Oligocene (Byram Marl), of Leaf River, Miss., U.S.A., which is apparently *P. advena*. Our specimens are connected by an intermediate form, with a smaller proloculum than Fig. 2, but larger than Fig. 4. This is represented by Fig. 3. Apparently we have here an example of what Hofker (1925, pp. 68-70) has termed trimorphism.

In our material there are examples with fewer chambers than usual. Similar specimens were met with by Cushman in his New Zealand collections, in company with *P. advena*. This character is also found in some of the British specimens of *P. corrugata*. The finding of the peculiar oval form of *Patellina* figured by Heron-Allen and Earland in their paper (1913, p. 109, pl. ix, fig. 11) on Clare Island foraminifera, in the dredging from off the Snares, S. of New Zealand, with typical *P. corrugata* and the

forms recorded by Cushman appears to be evidence that our identification of *P. corrugata* is correct. Heron-Allen and Earland regarded this oval form as being the microspheric stage of *P. corrugata*, with which it occurred. Our example is definitely megalospheric (Plate IV, fig. 5), and as it here also occurs with *P. corrugata*, it may prove to be a variety of that species, when more material is available. This oval form suggests the relationship of *Patellina* to *Patellinella*, which is brought out by a new species of the latter genus, which we describe below.

Occurrence.—Recent: dredgings, Geraldton Harbour, Western Australia; Bass Strait, off Gabo Island; E. of Tasmania, 1320 fms.; E. of Cape Saunders, Otago, N.Z., 40-50 fms.; off the Snares, S. of N.Z., 60 fms. Lower Pliocene (Kalimnan): Mallee Bores. Miocene (Janjukian); Mallee Bores. Oligocene (Balcombian): Balcombe Bay, Mornington; Kackeraboite Creek; and Muddy Creek, near Hamilton, Victoria.

Genus **Patellinella** Cushman, 1928.

Patellinella annectens, sp. nov.

(Plate IV, Fig. 6.)

Description.—Test subconical, depressed, trochoid, about 1½ times as long as broad, consisting of a small proloculum, followed by a short undivided coiled series, remaining chambers also undivided, arranged two to the whorl; sutures distinct, flush; wall calcareous, coarsely perforate; aperture at the base of the last-formed chamber. Length, 0·32 mm.; breadth, 0·25 mm.; height, 0·14 mm.

Holotype (Parr and Collins Coll.) from Oligocene (Balcombian), Muddy Creek, near Hamilton, collected by W. J. Parr.

Observations.—This is a particularly interesting species, showing, as it does, the relationship between the genera *Patellina* and *Patellinella*, which is clearly brought out by the figures of the two genera. It resembles *Patellina* in having the early portion of the shell coiled. It has also a similar deposit of shell substance on the under surface, formed by each chamber, and in this species extending as a thin lamina more than halfway across the inferior surface, that of each pair of chambers forming what may be described as a roughly sigmoidal depression, at the base of the last-formed portion of which lies the aperture. That it is a true *Patellinella* is shown by the lateral compression of the test, the textularian plan of growth, and the undivided character of the chambers. As might be expected from its appearance in the Oligocene, it is a more primitive form than *P. inconspicua*, which appears for the first time in the Post-Tertiary of Victoria.

Occurrence.—Oligocene (Balcombian): Muddy Creek, near Hamilton, Victoria.

PATELLINELLA INCONSPICUA (Brady).

(Plate IV, Fig. 7.)

Textularia inconspicua Brady, 1884, p. 357, pl. xlii, fig. 6*a-c*. Millett, 1899, p. 557, pl. vii, fig. 1.
Discorbis inconspicua (Brady): Cushman, 1919, p. 626.
Textularia inconspicua Brady: Heron-Allen and Earland, 1922, p. 116.
Patellinella inconspicua (Brady): Cushman, 1928, p. 5, pl. i, fig. 8*a-c*.

Observations.—This species was recorded by Brady from three "Challenger" stations in the Pacific, off East Moncoeur Island, Bass Strait; Nares Harbour, Admiralty Islands; and the *Hyalonema* ground, S. of Japan. Millett's examples from the Malay Archipelago are lower and more outspread than the specimen figured by Brady, which was from Bass Strait. Subsequent records are those of Cushman from off New Zealand, and Heron-Allen and Earland from the same area. The species is also known from the Kerimba Archipelago, off Portuguese East Africa.

Our specimens are all typical. The figured example, from the Post-Tertiary of Victoria, is an exceptionally large one, with strongly limbate sutures. The species seems to be subject to little variation, as examples from a depth of 1320 fms. agree in every respect with those from shallow water.

Occurrence.—Recent: shore sand, Point Lonsdale; Torquay; Port Fairy, Victoria; dredgings, E. of Tasmania, 1320 fms. Post-Tertiary: boring near Boneo, Victoria, 177-187 ft.

Annulopatellina, gen. nov.

Description.—Test depressed conical, concave on the inferior side, consisting of a globular proloculum, which is wholly or partly embraced by a crescentic to subcircular second chamber; remaining chambers annular and with the exception of the first two or three, always subdivided into chamberlets, which extend inwards on the under surface of the test in the form of tubular prolongations closed at the ends and sometimes anastomosing; wall calcareous, hyaline, perforate, thin; aperture apparently absent.

Observations.—This genus has been erected for the reception of Parker and Jones's *Orbitolina annularis*, which was later transferred to the genus *Patellina* by Carpenter. This species resembles *P. corrugata* and other typical species of the same genus in its depressed plano-convex test, and in the subdivision of the chambers, but its plan of growth is quite distinct. Instead of being built on a rotaline plan, with two or three chambers to the whorl, as in *P. corrugata*, the chambers are, with the exception of the proloculum and the following chamber, annular. The early undivided coils of *P. corrugata* are also absent from *A. annularis* in both megalospheric and microspheric forms. Further notes on the points of difference between the two genera will be found in the notes on *A. annularis*.

ANNULOPATELLINA ANNULARIS (Parker and Jones).

(Plate IV, Figs. 8, 9, 10.)

Orbitolina annularis Parker and Jones, 1860, pp. 30, 31.
Patellina corrugata Williamson: Carpenter (*pars*), 1862, p. 230, pl. xiii, figs. 16, 17.
Patellina annularis (Parker and Jones): Parker and Jones, 1865, p. 438.
Patellina corrugata Chapman (*non* Williamson), 1909A, p. 134, pl. x, fig. 7.
Patellina corrugata, var. *annularis* (Parker and Jones): Heron-Allen and Earland, 1922, p. 198.

Description.—The characters of the species are those of the genus.

Dimensions.—Diameter up to 1·2 mm.; height to 0·25 mm.

Observations.—This species was originally described from Australian shore sands, and the remainder of the records, with the exception of a somewhat doubtful one by Heron-Allen and Earland from off New Zealand, are all from the Australian coast. It is not known as a fossil.

Our own records are all from Australian waters, over an area extending from Geraldton, Western Australia, along the southern coast to as far east as Gabo Island. The specimens fall into two groups, one consisting of those with a large proloculum, followed by an undivided crescentic chamber, and then an annular series of up to twelve chambers, and the other, of much larger specimens, with a small proloculum, embraced by a kidney-shaped to subcircular chamber, subdivided into chamberlets, and followed by a greater number, up to as many as sixteen, annular chambers. The two groups clearly represent the megalospheric and microspheric forms of the species. The diameter of the proloculum of a megalospheric example measures 0·07 mm., and that of a microspheric specimen, 0·015 mm. The degree of fineness of the subdivisions of the annular chambers varies considerably, but not according to whether the specimen is megalospheric or microspheric. Plastogamy occurs in *A. annularis*, particularly in the material from Hardwicke Bay, South Australia, in which the paired shells and others which had become disunited are quite common. In every such case, it was found that most of the base and the whole of the septa had disappeared, having been absorbed in the process of reproduction.

Reference has already been made to the subdivision of the chamber surrounding the proloculum in the microspheric form. The number of these chamberlets is very variable, and it is difficult to determine just what their nature is. In one example, the apex of which is figured (fig. 10), they are undoubtedly similar to those in the later annular series. In others, including that figured by Mr. Chapman (*loc. cit. supra*), which he has kindly allowed us to examine, they have curved septa in a few, sometimes only one, of the chamberlets, which therefore seem to be of a rotaline

nature, although it should be stated that, to us, the outer septal face of some of these chamberlets appears concave or flat, not convex, as one would expect to find in a rotaline form. It was intended to figure several of these chamberlets, but an unfortunate accident resulted in the destruction of the specimens selected for figuring.

In the absence of anything definite regarding the nature of the early chamberlets in the microspheric form, the affinities of the genus remain obscure. When recording this species (as *Patellina corrugata*, var. *annularis*) from the "Terra Nova" dredgings, off New Zealand, Heron-Allen and Earland note the occurrence of other specimens representing transition stages between it and *P. corrugata*. No such specimens have been met with by us, the characters of *A. annularis*, judging by the plentiful material at our disposal, being very constant. If it is related to *Patellina*, the ontogeny of the microspheric form should provide evidence of the relationship, but this is lacking. The only point of resemblance is the subdivision of the chambers. More examples of the rather rare microspheric form are needed to clear up this interesting problem.

Occurrence.—Dredgings, Geraldton Harbour, Western Australia; shore sand, Hardwicke Bay; Glenelg, South Australia; Torquay; Point Lonsdale, Victoria; dredgings, off Gabo Island, Bass Strait.

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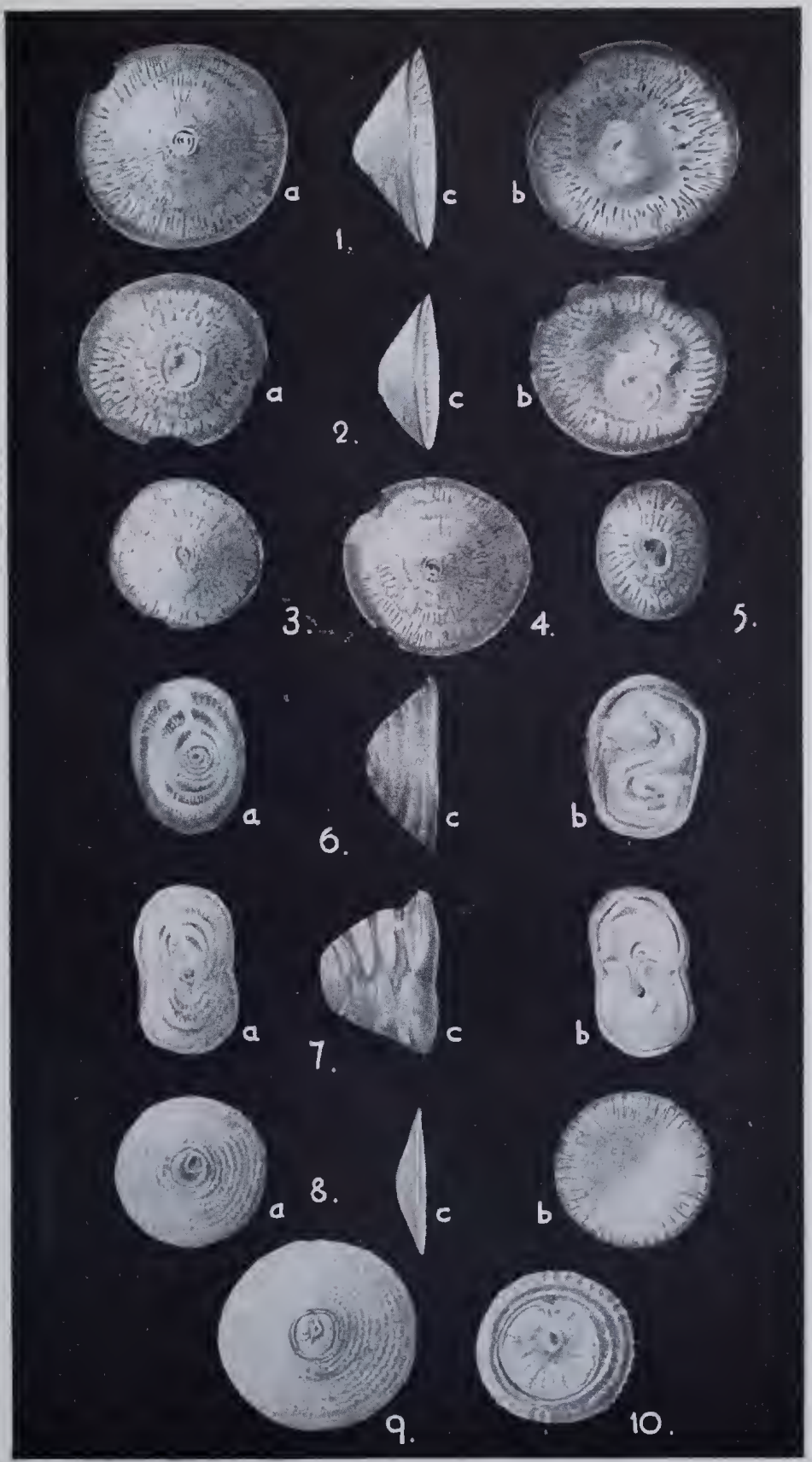

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Patellina, Patellinella and Annulopatellina.